

**Award Number: 02HQGR0016**

**ANALYSIS OF STRONG-MOTION RECORDS FROM THE UNIVERSITY OF  
KENTUCKY ACCELEROMETERS IN THE NEW MADRID  
SEISMIC ZONE: 1990 THROUGH 2001**

**Final Report**

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**June 16, 2003**

## **Abstract**

The scope of work for this proposal was to systematically review and process accelerograms from the University of Kentucky strong-motion stations in the New Madrid seismic zone for the years of 1990 through 2000. Records were processed using Kinematics software, and tabulated. Text files (.DOC) describing the earthquake recorded, the instrumentation at the strong-motion station, and peak ground motion parameters, as well as data files (.V2) are available to researchers at the *ftp* site: 128.163.49.14.

## **Introduction**

The University of Kentucky strong-motion network began operating in the fall of 1989. Locations of the strong-motion stations in the network, as well as the epicenters of the earthquakes that were recorded from 1990 through 2000, are listed in Table 1. The objective of this project was to systematically review the strong-motion records from the University of Kentucky strong-motion network for the years of 1990 through 2000, and to make them available for general research purposes. This brief report gives a general description of the records, background on the instrumentation, the specifics of the earthquakes for which the acceleration time histories were acquired, and the peak ground motion accelerations, velocities, and displacements for each component.

## **Discussion**

Table 1 is a list of the 103 time histories of earthquakes in the New Madrid seismic zone, that were acquired on the accelerometers in the University of Kentucky strong-motion network between 1989 and 2001. Magnitudes of the earthquakes, which are given in terms of their  $m_{b,Lg}$  (Nuttli, 1973), range from 1.6 to 4.5  $m_{b,Lg}$ . Data for the records were uniformly collected at 200 samples per second on Kinematics FBA-13 or 23 accelerometers, and SSA-1, SSA-2, or SSR-1 accelerographs. All of the accelerometers were operated as free-field instruments, except HIKY, which was bolted to the concrete floor in the National Guard Armory in Hickman, Kentucky, and the downhole FBA's at VSAB and VSAP.

During the first six months of 1993, VSAB consisted of a three-component free-field accelerometer and a three-component downhole accelerometer installed at a depth of 102 m. From early 1992 through 1995, the instrumentation at VSAP consisted of a three-component free-field accelerometer, a three-component downhole accelerometer installed at a depth of 41 m, and a three-component downhole accelerometer installed at a depth of 99 m. Site conditions at VSAB are described in Street *et al.* (1995), while site conditions and the placement of the accelerometers at VSAP, are described in Street *et al.* (1997).

Accelerograms from the strong-motion network were processed using Kinematics' software program, Seismic Workstation (Version 1-E, 1989). High-frequency filtering was topically done with a transition band of 45 to 50 Hz. Anti-aliasing for the Kinematics accelerographs used to collect the data, is accomplished by a two-pole, 50-Hz Butterworth filter. The transition band used in the low-frequency filtering varied, depending upon the record length, the magnitude of the event, and the noise level. Typically for the smallest of the events ( $<3 m_{b,Lg}$ ), the low-

frequency transition band was set at 2 to 4 Hz, whereas for larger events, the low-frequency transition band was set to 0.6 to 0.8 Hz or less. The exact transition bands used in the processing of the accelerograms, are indicated in the volume 2 header information given for each record.

The .DOC files summarizes the principle facts about the earthquake, the type of accelerometer, and other comments. The .V2 files, which are obtained at the *ftp* address given below, are the output from the Kinematics software used in the processing. For records 50 through 55, the .V2 files are missing, but the three-component acceleration, velocity, and displacement traces are included as .DAT files. The digital data for records 61 and 92 were lost in the transferring of the data, but analog copies of the acceleration, velocity, and displacement traces are available upon request. The digital data and associated .DOC files for the records can be obtained at the *ftp* address: 128.163.49.13 with *anonymous* login.

Table 2 shows the .DOC files for the first accelerogram (UKY0001) recorded on the University of Kentucky strong-motion network, as examples. UKY0001.DOC is the first file in Table 1, while UKY0001.v2 is the first strong-motion record at the *ftp* site.

Questions regarding the files should be directed to:

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## Summary

One hundred and nineteen accelerograms were reviewed and processed in this study. Of these, 103 were processed and included in the final report. The accelerograms and particulars about the earthquakes and the strong-motion stations can be downloaded at *ftp* site identified above.

## References Cited

- Nuttli, O.W. (1973). Seismic wave attenuation and magnitude relations for eastern North America, *Journal of Geophysical Research* 78, 876-885.
- Street, R., Z. Wang, E. Woolery, J. Hunt, and J. Harris (1997). Site effects at a vertical accelerometer array near Paducah, Kentucky, *Engineering Geology* 46, 349-367.
- Street, R., E. Woolery, Z. Wang, and J. Harris (1995). A short note on shear-wave velocities and other site conditions at selected strong-motion stations in the New Madrid seismic zone, *Seismological Research Letters* 66, 56-63.

**TABLE 1. University of Kentucky Strong-Motion Records Acquired Through 2000**

Record	Station	Date (m-d-y)	Epicenter (°N/°W)	m <sub>b</sub> <sup>1</sup>	Dist (km)	PGA PPV cm/s <sup>2</sup> cm/s
UKY0001	HIKY	8/26/90	37.16/89.58	4.5	76	2.98      0.075
UKY0002	WIKY	8/26/90	37.16/89.58	4.5	48	32.3      1.713
UKY0003	COKY	5/4/91	36.56/89.82	4.5	67	1.88      0.042
UKY0004	HIKY	5/4/91	36.56/89.82	4.5	57	1.88      0.050
UKY0005	COKY	6/7/91	36.75/89.27	2.5	14	2.43      0.020
UKY0006	HIKY	7/7/91	36.66/91.65	3.8	220	0.43      0.016
UKY0007	COKY	12/21/91	36.69/89.12	2.9	8	1.24      0.012
UKY0008	COKY	4/30/92	36.83/90.36	2.8	111	0.48      0.007
UKY0009	COKY	5/11/92	36.82/88.98	2.7	13	1.13      0.021
UKY0010	VSAP	8/18/92	37.12/88.85	2.0	3	20.6      0.117
UKY0011	VSAP	10/2/92	37.12/88.82	2.0	8	4.07      0.02
UKY0012	VSAP	10/2/92	37.12/88.76	2.0	8	8.03      0.06
UKY0013	HIKY	1/8/93	35.93/90.03	3.5	102	4.34      0.31
UKY0014	HIKY	2/6/93	36.66/89.73	3.3	50	9.69      0.35
UKY0015	RLTN	2/6/93	36.66/89.73	3.3	47	4.97      0.04
UKY0016	WIKY	2/6/93	36.66/89.73	3.3	48	2.49      0.03
UKY0017	LATN	2/24/93	36.16/89.46	2.7	7	8.51      0.09
UKY0018	COKY	3/2/93	36.67/89.49	3.0	35	1.32      0.03
UKY0019	HIKY	3/2/93	36.67/89.49	3.0	76	2.06      0.03
UKY0020	VSAB	3/22/93	36.67/89.49	3.0	16	7.79      0.07
UKY0021	VSAB	3/22/93	36.67/89.49	3.0	16	10.5      0.11
UKY0022	COKY	3/31/93	36.80/89.43	3.1	29	3.40      0.04
UKY0023	HIKY	3/31/93	36.80/89.43	3.1	35	1.99      0.02
UKY0024	WIKY	4/2/93	37.01/89.00	2.8	9	5.97      0.04
UKY0025	WIKY	4/2/93	37.02/89.02	2.8	8	3.26      0.04
UKY0026	COKY	4/28/93	36.20/89.44	3.7	68	1.32      0.03
UKY0027	HIKY	4/28/93	36.20/89.44	3.7	45	0.94      0.02
UKY0028	LATM	4/28/93	36.20/89.44	3.7	9	14.8      0.31
UKY0029	LATN	7/5/93	36.08/89.32	<2	9	4.47      0.04
UKY0030	COKY	8/5/93	36.01/89.89	3.0	108	0.73      0.01
UKY0031	HIKY	2/5/94	37.37/89.19	4.2	91	9.91      0.05
UKY0032	RLTN	2/5/94	37.37/89.19	4.2	108	2.75      0.09
UKY0033	VSAP	2/5/94	37.37/89.19	4.2	42	5.53      0.07
UKY0034	VSAP	2/5/94	37.37/89.19	4.2	42	13.5      0.19
UKY0035	VSAP	2/5/94	37.37/89.19	4.2	42	13.9      0.34
UKY0036	WIKY	2/5/94	37.37/89.19	4.2	45	6.05      0.13
UKY0037	COKY	3/21/94	36.86/89.17	3.1	12	6.79      0.12
UKY0038	VSAP	6/4/94	37.08/88.86	2.0	6	5.64      0.03
UKY0039	VSAP	6/4/94	37.08/88.86	2.0	6	11.6      0.07
UKY0040	VSAP	6/4/94	37.08/88.86	2.0	6	12.8      0.09
UKY0041	COKY	9/26/94	36.96/88.92	3.6	28	3.18      0.06
UKY0042	HIKY	9/26/94	36.96/88.92	3.6	51	0.86      0.02
UKY0043	WIKY	9/26/94	36.96/88.92	3.6	15	34.0      0.29
UKY0044	VSAB	12/31/94	36.49/89.55	2.0	5	7.75      0.051

UKY0045	VSAB	2/22/95	36.60/89.35	1.5	16	3.86	0.027
UKY0046	VSAB	1/31/95	36.51/89.56	2.3	5	2.77	0.031
UKY0047	COKY	4/15/95	36.76/89.11	<2	0	1.96	0.018
UKY0048	VSAB	4/24/95	36.68/89.58	2.3	18	2.68	0.026
UKY0049	VSAB	4/27/95	36.70/89.49	2.8	19	14.2	0.126
UKY0050	COKY	5/27/95	36.18/89.44	3.8	70	2.75	0.035
UKY0051	HIKY	5/27/95	36.18/89.44	3.8	47	1.60	0.046
UKY0052	LATN	5/27/95	36.18/89.44	3.8	7	18.5	0.138
UKY0053	RLTN	5/27/95	36.18/89.44	3.8	26	6.96	0.139
UKY0054	VSAB	5/27/95	36.18/89.44	3.8	39	10.3	0.122
UKY0055	WIKY	5/27/95	36.18/89.44	3.8	93	7.04	0.058
UKY0056	COKY	6/6/95	36.22/89.47	3.2	68	0.79	0.011
UKY0057	HIKY	6/6/95	36.22/89.47	3.2	45	0.61	0.012
UKY0058	LATN	6/6/95	36.22/89.47	3.2	12	6.15	0.135
UKY0059	RLTN	6/6/95	36.22/89.47	3.2	24	3.95	0.059
UKY0060	VSAB	6/6/95	36.22/89.47	3.2	34	4.34	0.056
UKY0061	VSAB	6/29/95	36.59/89.77	2.8	24	6.21	0.072
UKY0062	VSAB	7/20/95	36.55/89.58	2.7	7	29.4	0.312
UKY0063	LATN	8/17/95	36.22/89.33	3.0	12	7.22	0.111
UKY0064	LATN	8/25/95	36.19/89.47	2.5	10	5.57	0.059
UKY0065	VSAB	10/4/95	36.42/89.48	1.9	12	4.83	0.042
UKY0066	VSAB	11/24/95	36.55/89.91	2.8	27	6.54	0.071
UKY0067	VSAB	12/20/95	36.52/89.16	2.2	9	36.5	0.200
UKY0068	VSAB	2/17/96	36.52/89.68	2.4	15	20.2	0.254
UKY0069	COKY	11/29/96	35.90/89.97	4.3	122	2.72	0.071
UKY0070	HIKY	11/29/96	35.90/89.97	4.3	100	5.57	0.208
UKY0071	RLTN	11/29/96	35.90/89.97	4.3	80	6.15	0.115
UKY0072	VSAB	11/29/96	35.90/89.97	4.3	81	50.3	1.193
UKY0073	WIKY	11/29/96	35.90/89.97	4.3	142	5.02	0.132
UKY0074	RLTN	11/29/96	36.34/89.40	3.5	9	2.21	0.063
UKY0075	VSAB	11/29/96	36.34/89.40	3.5	23	3.76	0.055
UKY0076	VSAB	9/24/97	36.65/89.73	3.2	24	2.83	0.023
UKY0077	LATN	9/27/97	36.18/89.41	3.2	6	4.61	0.093
UKY0078	VSAB	12/2/97	36.57/89.51	2.7	5	330.	3.32
UKY0079	VSAB	1/9/97	36.56/89.52	2.2	4	80.3	1.013
UKY0080	VSAB	2/12/98	36.14/89.71	3.0	46	2.06	0.037
UKY0081	VSAB	2/19/98	36.54/89.57	2.7	6	22.7	0.479
UKY0082	VSAB	2/19/98	36.48/89.56	1.9	7	9.42	0.087
UKY0083	VSAB	2/26/98	36.36/89.58	2.5	20	24.6	0.316
UKY0084	VSAB	3/13/98	36.26/89.61	2.0	31	8.57	0.049
UKY0085	VSAB	3/21/98	36.15/89.47	1.6	42	3.54	0.030
UKY0086	VSAB	4/8/98	36.92/89.02	3.0	61	3.01	0.036
UKY0087	VSAB	4/9/98	36.43/89.53	2.7	11	7.22	0.085
UKY0088	VSAB	7/15/98	36.69/89.52	3.1	18	22.1	0.350
UKY0089	VSAB	3/18/99	36.53/89.61	2.3	9	15.7	0.175
UKY0090	VSAB	4/16/99	36.46/89.52	1.6	8	5.11	0.044
UKY0091	VSAB	6/22/99	36.50/89.53	2.1	4	13.9	0.084

<b>UKY0092</b>	<b>VSAB</b>	<b>8/1/99</b>	<b>36.53/89.54</b>	<b>2.3</b>	<b>3</b>	<b>9.40</b>	<b>0.140</b>
<b>UKY0093</b>	<b>LATN</b>	<b>8/23/99</b>	<b>36.26/89.52</b>	<b>3.2</b>	<b>18</b>	<b>4.26</b>	<b>0.075</b>
<b>UKY0094</b>	<b>VSAB</b>	<b>8/23/99</b>	<b>36.26/89.52</b>	<b>3.2</b>	<b>30</b>	<b>9.40</b>	<b>0.136</b>
<b>UKY0095</b>	<b>VSAB</b>	<b>9/3/99</b>	<b>36.42/89.52</b>	<b>2.3</b>	<b>12</b>	<b>8.33</b>	<b>0.093</b>
<b>UKY0096</b>	<b>VSAB</b>	<b>9/11/99</b>	<b>36.46/89.55</b>	<b>2.1</b>	<b>8</b>	<b>8.04</b>	<b>0.113</b>
<b>UKY0097</b>	<b>VSAB</b>	<b>9/13/99</b>	<b>36.48/89.48</b>	<b>2.6</b>	<b>6</b>	<b>5.84</b>	<b>0.094</b>
<b>UKY0098</b>	<b>VSAB</b>	<b>9/15/99</b>	<b>36.56/89.48</b>	<b>2.5</b>	<b>4</b>	<b>97.4</b>	<b>0.687</b>
<b>UKY0099</b>	<b>LATN</b>	<b>10/21/99</b>	<b>36.49/91.02</b>	<b>3.9</b>	<b>150</b>	<b>1.71</b>	<b>0.042</b>
<b>UKY0100</b>	<b>VSAB</b>	<b>10/21/99</b>	<b>36.49/91.02</b>	<b>3.9</b>	<b>134</b>	<b>4.23</b>	<b>0.108</b>
<b>UKY0101</b>	<b>VSAB</b>	<b>12/9/99</b>	<b>36.58/89.60</b>	<b>2.2</b>	<b>10</b>	<b>11.2</b>	<b>0.142</b>
<b>UKY0102</b>	<b>VSAB</b>	<b>1/27/00</b>	<b>36.53/89.49</b>	<b>2.8</b>	<b>2</b>	<b>41.9</b>	<b>0.775</b>
<b>UKY0103</b>	<b>VSAB</b>	<b>2/22/00</b>	<b>36.55/89.70</b>	<b>2.2</b>	<b>17</b>	<b>3.92</b>	<b>0.055</b>

**Table 2. Example of DOC file**

**UNIVERSITY OF KENTUCKY  
KENTUCKY GEOLOGICAL SURVEY**

**STRONG-MOTION RECORDING NO. 1**

**STATION:** HIKY

**EARTHQUAKE OF:**

Date: SEP. 26, 1990  
Location: 37.16°N/89.58°W  
Time: 13:18 GMT  
Depth: 14 km  
Magnitude: 4.5 m<sub>b,Lg</sub>

**RECORDING PARAMETERS:**

Instrumentation: SSA-1  
Sampling Rate: 200 sps

Location: 36.551°N/89.183°W

**Orientation of Components:**

Component 1: 080°  
Component 2: Vertical  
Component 3: 170°

Site Conditions: Concrete floor of Armory  
Alluvium

**COMMENTS:**

Epicentral Distance: 76 km

**PEAK PARTICLE MOTIONS:**

Component	Accel. (cm/s <sup>2</sup> )	Vel. (cm/s)	Disp. (cm)
1	2.57	0.075	0.0055
2	2.47	0.044	0.0015
3	2.98	0.066	0.0031